Switchgear

The invention relates to a switching device according to the preamble of Claim 1.

Switching devices are known which, in the event of excess currents in a wiring network, which last longer than a specifiable time, disconnect this wiring network from a supply network, in order to prevent the further supply of electrical current. Furthermore, switching devices are known which, in the event of a short-circuit in a wiring network, disconnect this wiring network from a supply network, in order to prevent the further supply of electrical current. Switching devices of this type therefore have a disconnection device, which particularly works together with a so-called overcurrent triggering device or a short-circuit triggering device, which triggers the mechanical disconnection device in the event of a response, which disconnects the switch contacts of the switching device, and prevents the further current flow. The overcurrent triggering device or the short-circuit triggering device typically acts mechanically on a mechanical trigger of the disconnection device. In addition to the triggering of the disconnection device by a triggering device, an actuating lever is typically provided, using which the disconnection device can be controlled so that it disconnects the switch contacts.

Upon disconnection of the switch contacts, because of the physical conditions which are described in the law of induction, an electrical arc occurs between the disconnecting switch contacts. In the event of a short-circuit in a wiring network, very high currents in the range between 5 kA up to 25 kA may occur, for example. Therefore, if a shutdown of the switching device occurs because of a short-circuit, the switch contacts must interrupt a very high electrical current. The electrical arc thus arising is correspondingly strong and would result in destruction of the switching device in a switching device without special equipment. Such switching devices therefore typically have a so-called electrical arc quenching chamber, which conducts the occurring electrical arc and withdraws energy therefrom, until it is quenched. For this purpose, the electrical arc quenching chamber has a row of metal plates, which are also referred to as deion plates. These metal plates, which are typically implemented identically, are situated parallel to one another uniformly inside the electrical arc quenching chamber in the case of known switching devices. This has the disadvantage that individual metal plates are often more strongly strained by an electrical arc than others, whereby the individual metal plates within an electrical

arc quenching chamber are worn to different extents. Such strong wear of individual metal plates can occur that the further operational reliability of the switching device is no longer provided. This is all the more hazardous because such flaws are not externally recognizable, and the further operational safety of the switching device is suggested to the user.

The object of the invention is therefore to specify a switching device of the type cited at the beginning, using which the mentioned disadvantages may be avoided, which has high reliability and operational safety even after repeated shutdown, and also has low production costs.

This is achieved according to the invention by the features of Claim 1.

A switching device can thus be provided which has high reliability and operational safety even after repeated shutdown. Through the implementation according to the invention of the electrical arc quenching chamber, the particularly strongly strained metal plates within the electrical arc quenching chamber can withstand this high strain unharmed even over a long period of usage time, whereby it can be ensured that no hazards arise due to a defective electrical arc quenching chamber. Through the configuration adjacent to one another of two metal plates implemented essentially identically, the production costs may further be kept low, because no further special part must be manufactured and kept in storage. The burning up of the most strained metal plates within the electrical arc quenching chamber can thus be reliably prevented.

The subclaims, which simultaneously form a part of the description like Claim 1, relate to further advantageous embodiments of the invention.

The invention is described in greater detail with reference to the appended drawings, in which preferred embodiments are shown solely for exemplary purposes.

In the figures:

Figure 1 shows a preferred embodiment of a switching device according to the invention in an axonometric exploded view; and

Figure 2 shows the electrical arc quenching chamber according to Figure 1 in an axonometric view having one housing half removed.

Figure 1 shows a switching device 1, in particular a circuit breaker, having at least one input terminal 2 and at least one output terminal 3 for connecting electrical conductors, and having a first switch contact 4 and a second switch contact, the switch contacts 4 closing a current path between

the input terminal 2 and the output terminal 3 in a closed position, a disconnection device 6 being provided for disconnecting the first switch contact 4 and the second switch contact, at least one electrical arc quenching chamber 9 being situated in the area of the switch contacts 4, in which a specifiable plurality of metal plates 10 are situated, at least two of the metal plates 10 being situated at least regionally pressing against one another.

A switching device 1 can thus be provided, which has high reliability and operational safety even after repeated shutdown. Through the implementation according to the invention of the electrical arc quenching chamber 9, the particularly strongly strained metal plates 10 within the electrical arc quenching chamber 9 can withstand this high strain unharmed even over a long period of operating time, whereby it can be ensured that no hazards arise due to a defective electrical arc quenching chamber 9. Through the configuration adjacent to one another of two essentially identically implemented metal plates 10, the production costs may further be kept low, because no further special part must be manufactured and stored. The burning up of the most strained metal plates 10 within the electrical arc quenching chamber 9 can thus be reliably prevented.

Figure 1 shows a row of assemblies of a preferred embodiment of a switching device 1 according to the invention as a circuit breaker in an axonometric exploded view. An embodiment of a switching device 1 is shown having three switching gaps or current paths, any specifiable number of switching gaps or switchable current paths being able to be provided. Switching devices 1 according to the invention are preferably provided with one, two, three, or four current paths. The same number of input terminals 2 or output terminals 3 are provided corresponding to the number of current paths. In the figures, only housing-fixed parts of the input terminals 2 or output terminals 3 are shown. The relevant input terminals 2 or output terminals 3 typically comprise, in addition to the parts shown, at least one terminal screw, and preferably at least one terminal jaw movable using the terminal screw in each case.

In the preferred embodiment shown, the switching device 1 comprises an insulation material housing, which comprises a lower housing shell 17 and an upper housing shell 18 in the preferred embodiment. The at least one first switch contact 4 rests in a closed position on the at least one second switch contact, which is situated inside the assembly of the electrical arc quenching

chamber 9 in the embodiment shown. Switching devices 1 according to the invention preferably have an overcurrent triggering device 7 and/or a short-circuit triggering device 8.

In the preferred embodiment shown, the short-circuit triggering device 8 is formed from a U-shaped yoke and a movable armature, the U-shaped yoke being fastened on a first conductor of the current path, which is preferably assigned to the input terminal 2 and/or the output terminal 3. The movable armature is mounted so it is rotatable on the U-shaped yoke, which is forced by a movable armature spring into an idle position, in which idle position the movable armature stands away from the U-shaped yoke. Upon occurrence of a short-circuit, the currents through the switching device 1 are sufficiently high that the U-shaped yoke attracts the movable armature, whereby a first end of the movable armature is deflected, and this first end of the movable armature causing the further triggering of the disconnection device 6, and therefore the disconnection of the switch contact 4.

The overcurrent triggering device 7 comprises a bimetal element, which is fastened on the first conductor. In the illustrated preferred embodiment, the bimetal element has current flowing directly through it, i.e., it is part of the current path itself, and is directly heated by the current. However, it can also be provided that the bimetal element is completely or additionally indirectly heated, in that, for example, a conductor having current flowing through it is situated on the bimetal element. With increasing heating of the bimetal element because of the current flow, it is bent ever further. At a specifiable degree of the bending of the bimetal element, which is proportional to a specifiable heating of the wiring network, it moves the triggering shaft 19, which causes the further triggering of the disconnection device 6, and therefore the disconnection of the switch contacts 4.

In a switching device 1 according to the invention, the overcurrent triggering device 7 and/or the short-circuit triggering device 8 does not act directly on the disconnection device 6, but rather via a deflection lever, which is implemented in the present preferred embodiment as a triggering shaft 19.

In the illustrated particularly preferred embodiment of the invention, the disconnection device 6 is implemented as a switch latch. The switch latch is a force-storing connecting link between an actuating lever 20 and the switch contacts 4. The switch latch is tensioned in a first movement

direction in the present implementation in a first step using movement of the actuating lever 20, a spring force accumulator being tensioned, which ensures rapid and reliable disconnection of the switch contacts 4 upon triggering of the switch latch.

Switching devices according to the invention have one electrical arc quenching chamber 9 for each pair of switch contacts 4, therefore for each pair of at least one housing-fixed and at least one movable switch contact 4, which are assigned to the same switch gap or switch the same switch gap, within which quenching chamber a specifiable plurality of metal plates 10 are situated, which are preferably formed from a thermally resistant metal, in particular comprising steel. The preferred embodiment of an electrical arc quenching chamber 9, which is shown in detail in Figure 2, has a two-part housing 14 made of insulating material, which is preferably formed from a duroplastic. In the illustration according to Figure 2, one of the two housing parts is removed, to allow an illustration of the internal construction of the electrical arc quenching chamber 9. A specifiable plurality of perforations for receiving the metal plates 10 are situated in the housing 14, in particular in each of the individual housing parts. A particularly simple construction of an electrical arc quenching chamber 9 is thus made possible, the configuration of the metal plates 10 within the electrical arc quenching chamber 9 being freely specifiable in broad ranges, and the individual metal plates 10, which are mounted using a projection in the perforations of the housing 14, being anchored securely and permanently, whereby the operational safety of a switching device 1 according to the invention is further increased.

In the preferred embodiment of the invention, the second switch contact is implemented as a fixed switch contact. The electrical arc quenching chamber 9 is situated in the area of the second switch contact. In particular, the electrical arc quenching chamber 9 delimits the area between the second switch contact and the open position of the first switch contact 4, which is implemented as the movable switch contact 4. The second switch contact is situated in the illustration according to Figure 2 directly above a shielding plate 5, which is particularly implemented comprising iron, and below the metal plates 10, the second switch contact being concealed by the metal plates 10 in Figure 2. The second switch contact is connected to the output terminal 3, which is guided in a loop below the electrical arc quenching chamber 9, and ends in the second switch contact. Through the looped implementation of the second switch contact, in the event of

high currents, which are to be expected in the event of an occurring short-circuit, an electromotive force arises at the second switch contact, which results in a repulsion of the first switch contact 4 from the second switch contact. The disconnection action of the first from the second switch contact 4 in case of short-circuit can thus be substantially accelerated.

In order to move or guide the first switch contact 4 within the electrical arc quenching chamber 9, in a first area 11, it has a first opening 12 for leading through the first switch contact 4. Furthermore, it is provided that the metal plates 10 have a U-shaped recess 13. An opening first switch contact 4 can thus always be enclosed by metal plates, whereby a rapid dissipation of the electrical arc from the switch contacts 4 can be achieved. Furthermore, through the U-shaped implementation of the metal plates 10, the surface area of the metal plates 10 is increased, whereby their cooling is particularly effective, and a large amount of energy can be withdrawn sufficiently rapidly from the electrical arc that it can be caused to extinguish.

It is provided according to the invention that at least two of the metal plates 10 are situated at least regionally pressing against one another, it being provided in particular that the first metal plate 10, 26, which is most strongly loaded by a switching action, is assigned to a second metal plate 10, 27, which is situated at least regionally pressing against the first metal plate 10, 27. It has been shown that it is particularly advantageous if the two metal plates 10 which are situated closest to the second switch contact are the two metal plates 10 which are situated at least regionally pressing against one another, as is also provided in the embodiment of an electrical arc quenching chamber 9 according to Figures 1 and 2. It is particularly preferably provided that the two metal plates pressing against one another are implemented essentially identically and are situated essentially completely on top of one another. Above all, the load of individual metal plates 10 in the direct surroundings of the occurrence of an electrical arc can thus be reduced.

According to a particularly preferred refinement of the present invention, it is preferably provided that the metal plates 10 are situated at least regionally in a fan shape inside the electrical arc quenching chamber 9, as is also shown in the embodiment shown in Figures 1 and 2, whereby a particularly advantageous guiding of the electrical arc, and a particularly effective dissipation, which is favorable for the flow, of the ionized gases generated by the electrical arc can be achieved. A fan-shaped configuration is preferably any type of configuration in which the

distance between two adjacent metal plates 10 increases continuously from the first opening 12 toward an outlet. In this context, it is particularly preferably provided that the metal plates 10 are situated following the movement line of the first switch contact 4.

In the present preferred embodiment, the first opening is closed by a closure part 15, which has a slot 16, through which the contact carrier 25 of the first switch contact 4 engages. In contrast to the housing 14 of the electrical arc quenching chamber 9, the closure part 15 is formed from a thermoplastic. While the housing 14 of the electrical arc quenching chamber 9 withstands the high temperatures which prevail in the surroundings of an electrical arc without melting, in the case of the closure part 15 formed from a thermoplastic, an intentional material ablation occurs due to the electrical arc. An essentially specifiable small part of the surface of the closure part 15 is vaporized by the energy of the electrical arc, whereby a local overpressure is generated, which helps to drive the electrical arc and the further ionized gases which arise in the direction toward at least one outlet, which is situated in or on the electrical arc quenching chamber 9 for the escape of ionized gases. The at least one outlet is not visible in the illustrations of the electrical arc quenching chamber according to Figures 1 and 2, but its approximate position is shown by the arrow 22. The outlet is situated in the area of a terminal screw tunnel 23, which is part of an electrical arc quenching chamber 9 in the present implementation thereof.

The closure 15 has a receptacle 24 adjacent to the slot 16 in each case in its preferred embodiment, which are situated essentially parallel to the slot 16 and/or parallel to the movement direction of the first switch contact 4, and in each of which a conductor plate 21 is situated. These conductor plates 21, which are preferably implemented comprising iron, generate an electromotive force during a shutoff action, which further accelerates the contact carrier 25 of the first switch contact 4 during its movement within the slot 16 and thus supports the rapid opening of the switch contacts 4.

Further embodiments according to the invention have only a part of the described features, any combination of features, in particular also of various described embodiments, being able to be provided.

PATENT CLAIMS

1. A switching device (1) having at least one input terminal (2) and at least one output terminal (3) for connecting electrical conductors, and having a first switch contact (4) and a second switch contact, the switch contacts (4) closing a current path between the input terminal (2) and the output terminal (3) in a closed position, a disconnection device (6) being provided for disconnecting the first switch contact (4) and the second switch contact (5), at least one electrical arc quenching chamber (9) being situated in the area of the switch contacts (4), in which a specifiable plurality of metal plates (10) are situated, **characterized in that** at least two of the metal plates (10) are situated at least regionally pressing against one another.

2. The switching device (1) according to Claim 1, **characterized in that** the metal plates (10) are situated at least regionally in a fan shape inside the electrical arc quenching chamber (9).

3. The switching device (1) according to Claim 1, **characterized in that** the second switch contact is implemented as a fixed switch contact, and the electrical arc quenching chamber (9) is situated in the area of the second switch contact.

4. The switching device (1) according to Claim 3, **characterized in that** the two metal plates (10), which are situated closest to the second switch contact, are situated at least regionally pressing against one another.

5. The switching device (1) according to Claim 1, **characterized in that** the first switch contact (4) is implemented as a movable switch contact, and the electrical arc quenching chamber (9) has a first opening (12) in a first area (11), for leading through the first switch contact (4).

6. The switching device (1) according to Claim 1 or 2, **characterized in that** the metal plates (10) are situated following the movement line of the first switch contact (4).

7. The switching device (1) according to Claim 1, **characterized in that** the metal plates (10) have a U-shaped recess (13).

8. The switching device (1) according to Claim 1, **characterized in that** the electrical arc quenching chamber (9) has at least one outlet for the escape of ionized gases.

9. The switching device (1) according to Claim 5, **characterized in that** the distance between two adjacent metal plates (10) increases continuously from the first opening (12) toward the outlet.

10. The switching device (1) according to Claim 1, **characterized in that** the electrical arc quenching chamber (9) has a housing (14), which is formed from a duroplastic.

11. The switching device (1) according to Claim 10, **characterized in that** perforations are situated in the housing (14) to receive the metal plates (10).

12. The switching device (1) according to one of Claims 5 through 11, **characterized in that** at least one conductor plate (21) is situated parallel to the first opening (12) in each case on both sides of the first opening (12).

13. The switching device (1) according to Claim 5, **characterized in that** a closure part (15), which has a slot (16), is situated in the area of the first opening (12).

14. The switching device (1) according to Claim 13, **characterized in that** the closure part (15) is formed from a thermoplastic.

15. The switching device (1) according to Claim 13 or 14, **characterized in that** at least one conductor plate (21) is situated parallel to the slot (16) in each case on both sides of the slot (16).

16. The switching device (1) according to Claim 1, **characterized in that** it is implemented as a circuit breaker.